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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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SCIENCE

NEW YORK, MARCH 3, 1893.

LAWS AND NATURE OF COHESION.

BY REGINALD A. FESSENDEN, LAFAYETTE, IND.

In a previous note (*Science*, July 22. 1892, and *Elect. World*, Aug. 8, 1891) a number of reasons were advanced for believing that cohesion is due to an electrostatic force, and it was shown that the results predicted by such a theory agree very closely with the results of experiment.

This theory was, however, only extended to the phenomena of rigidity, elasticity, and tensile strength. It was purposed to follow it with another note on the phenomena of conductivity, surface tension, solution, refraction of light, and compression of gases. Pressure of other work and the necessity of making experiments to determine some doubtful points, will prevent such publication for some time, and it was therefore judged best to give a short preliminary statement of a few of the results so far obtained.

I. Relative closeness of the atoms. It appears to be generally considered that the atoms are at distances from each other which are large in comparison with their diameters, even in the solid state. As an example of the extent of this belief may be mentioned the fact that in a recent article on magnetism, Mr. Steinmitz made the statement that Professor Ewing's theory could not be correct, unless the atoms were close together, but as they were far apart, his theory must be wrong. This conclusion has not been attacked up to the present time But the facts are that all our evidence points the other way, and it is almost absolutely certain that in the solid state the distance between the centres of two neighboring atoms is almost the same as their diameters.

For instance, from Van der Waals' equation we have, at the critical point:—

Volume of gas = 12 times the volume of the atoms themselves, or, the distance between the centres of two atoms is 2.3 times the diameter of a single atom. And this is just at the critical point, so that from the curves of volume, pressure and temperature, the solid elements must have a volume of, at the most, six times that of the atoms themselves, reducing the distance between centres to 1.8 times the atomic diameter.

Again, when a body is at absolute zero it is extremely difficult to conceive why the atoms, having no kinetic energy and the cohesive force still in existence, should not join together so closely as is possible, i.e., till they touch. (We may discard the old "force point" atom as obsolete and without reason for existence, all modern research and theory being in favor of the idea that atoms have most exact and well-defined boundaries.)

If, then, the atoms of silver in the solid state at 0° C., say, were very far apart, then, since we know its change of volume is very slight down to about $-200°$ C., there must be a most remarkable and sudden change at some point in the last 73°. But this is not to be believed, for it is impossible for any such violent change in the space occupied by the atoms to take place without some change in the conductivity of the metals. And we know from the researches of Dewar and others that the curve of resistance is a straight one, and cuts the axis of temperature at absolute zero, if produced.

On the other side, after considerable search, there does not appear to be any reason for believing that the atoms are widely separated in a solid, and the writer would be glad to know of any such reason, other than the fact that certain mathematicians have seen fit to make the supposition because it renders son e of the work on surface-tension, etc., a little easier to handle.

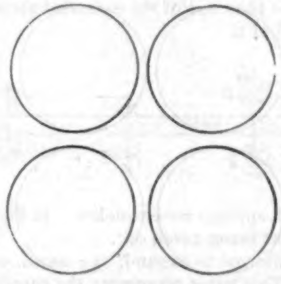
There is, it is true, one fact which is commonly considered as evidence of this nature, but which must rather be looked upon as evidence to the contrary. This is the fact that some elements have a greater volume by themselves than in combination. For instance, 45.5 cubic centimeters of potassium combine with an equivalent of chlorine to form a mass of potassium chloride which occupies only 37.4 cubic centimeters. But a simple geometric consideration will show us that even if the atoms of potassium were actually touching one another in the solid state, the 45.5 cubic centimeters would be able to contract to 31.7 cubic centimeters if the potassium were combined with an element having an atomic volume of less than 18. Similarly, 23.5 cubic centimeters sodium should be capable of combining with an element having an atomic volume of 9.6 to form a compound having an atomic volume of 16.5.

To take another example, sodium chloride should have an atomic volume of about $\{(23.5 \times .92) + 17\} \times \sqrt{\frac{1}{2}} = 27.02$. The actual atomic volume of *Na Cl* is 27.1. *Na OH* should have an atomic volume of 17. Its actual volume is 18.

K O H should have atomic volume of 25.5. Actual volume is 27.

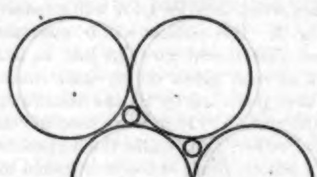
Similarly with the salts of cæsium, rubidium and the other metals which have large atomic volumes. For, of course, it is only with these elements which have great atomic volumes that this contraction on combination will be very noticeable.

The geometric explanation referred to is that in a monoplex element (element having under the conditions taken only one atom to the molecule), owing to the forces at work, the atoms will take the positions that a lot of balloons would that were fastened together by very short strings, thus,



four atoms occupying four times the space of one.

While if a new element is introduced, they will take this position



(shown in two dimensions only) where the atoms occupy a space $\sqrt{\frac{1}{2}} = .70$ of what they did originally. The fact that the calculated values are always a little smaller than the observed, and never larger, is one of the strongest proofs that the atoms are really fairly close together in the solid state. While this is to be regretted from a mathematical point of view, it is very satisfactory from a physical and crystallographic standpoint.

[NOTE.—In passing it is curious to note that the number of "space nets" into which an infinite number of points

(each point similarly situated to every other point) may be arranged is sixty-six, or just the number of the well-defined elements. So that imagination may picture Spencer's homogeneous cloud of atoms splitting up into these different "space net" arrangements, each kind of net being a different element.]

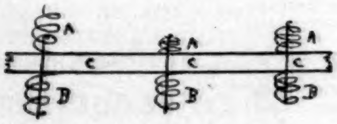
2. Solution. The chief opponent of the disassociation theory of solution is Professor Pickering; and his chief argument against it (for, of course, the disassociation theory allows the formation of hydrates as well as Professor Pickering's own hydrate theory does) is the fact that while disassociation almost always takes place with absorption of heat, solution generally emits it. This anomaly can be explained very satisfactorily by the electrostatic theory of cohesion. For whether a substance is a solid (or fluid) or a gas depends on whether the fraction

$$\text{I.}\qquad \frac{\text{cohesive force of atoms.}}{\text{repulsive force due to kinetic energy of atoms + attraction of atoms for other atoms}}$$

is greater or less than unity. We can thus turn a substance into a gas by either decreasing the numerator or increasing the denominator. The numerator we cannot change. The first term of the denominator we can increase by heating the substance, the second term by placing the substance in contact with a solvent.

In the last case the atoms of the solid part company with each other. But their cohesive force is not lost; it is simply added to that of the solvent, as shown by the increase of surface tension and of boiling point of a solution over that of the solvent. Since the solvent takes up the stress there is no necessary evolution or absorption of heat. A mechanical simile will make my meaning clear: Suppose a spiral spring, *A*, fixed on a board, *C*, which when compressed gives out heat from some reversible cause, so that it will absorb the same amount of heat in expanding. This is similar to the behavior of a gas — when compressed it gives out heat, when it expands again it absorbs heat.

But now suppose a second spring, *B*, placed beneath the board, *C*, similar in every respect to the first spring, and its axis a prolongation of that of *A*. Suppose an iron rod fastened to the bottom of *C*, extending up the centre of both springs, the rod being somewhat longer than one of the extended springs, and having a hook on the end of it.



In Fig. 1 both springs are extended. In Fig. 2, the spring *A* is compressed, heat being given out.

If it is now allowed to expand, the same amount of heat will be absorbed. This latter represents the turning of a solid into a gas by heating it.

But suppose, being compressed, the iron rod is hooked over the top of it. Then when it is let go it will expand and assume the position of Fig. 3. But no heat will be generated in the system, for it is evident that *B* will give out just as much as *A* absorbs. If the amount of heat given off by unit contraction of *A* were greater than that given off by *B*, the resultant effect would be a cooling of the system. If it were less, the resultant would be a heating. So we see, that while the expansion of *A* by itself would always absorb heat; when it is joined to *B*, the resultant effect depends on *B*.

Now, this is a very fair simile of what goes on when a solid is dissolved in a solvent. The solid loses its stress, which is taken up by the solvent, the result being an increase of cohesion between the molecules of the solvent, producing as a natural consequence increase of surface tension, lowering of the freezing point, and raising of the boiling point.

If the added electrostatic strain produces a greater amount of heat in the solvent than the loss of strain in the solid would absorb heat, the resultant would be a heating of the whole solution. Since, when a dissolved substance is plated out by electrolysis, the result resembles the cutting of the iron rod, *D*, in Fig. 3, there is an absorption of energy or cooling, so that work must be done to plate the dissolved substance out, and the electromotive force necessary to do this, since the ampères are constant for all equivalents, must depend on the rate at which the surface tension varies per withdrawal of unit weight of the electrolysed substance, allowing also for any heating or cooling during the electroplating.

3. Compression of gases. The ordinary formula for the compression of gases is that of Van der Waals, i.e.: —

$$\text{I.}\qquad \left(p+\frac{a}{v^2}\right)\left(v-b\right)=RT.$$

If the electrostatic theory of cohesion is correct, the equation should read

$$\text{II.}\qquad \left(p+\frac{a}{v^{\frac{4}{3}}}\right)\left(v-b\right)=RT.$$

for reasons evident to those who have read the previous note (*Science*, Aug. 22, 1892).

This is no longer a cubic, and it is pretty certain that the equation for the compression of gases should be one on account of the shape of the pressure-volume curves of carbonic acid gas. But we can transform the above equation, II., into a cubic by putting a, no longer as a constant but equal to a constant multiplied by $v^{\frac{2}{3}}$. The equation then reads: —

$$\text{III.}\qquad p+\frac{c\times v^{\frac{2}{3}}}{v^2}\Big)\left(v-b\right)=RT.$$

in which c is the same for all gases. The experimental data agree with this modified equation, as shown by table I.

Table I.

Substance.	$a \times 10{,}000$.	v (*ab*).
Dyethylamine	355	58
Ethyl. Acet.	348	55
Ether	324	57
Benzine	(438)	51
Ethyl. Form.	304	48
Chloroform	287	44
Acetone	273	44
Methyl. Acet.	248	39
Alcohol	236	37
Ethyl. Chlor.	227	40
CS_2	219	33
SO_2	123	24
NO_2	(74)	19

as closely as can be expected.

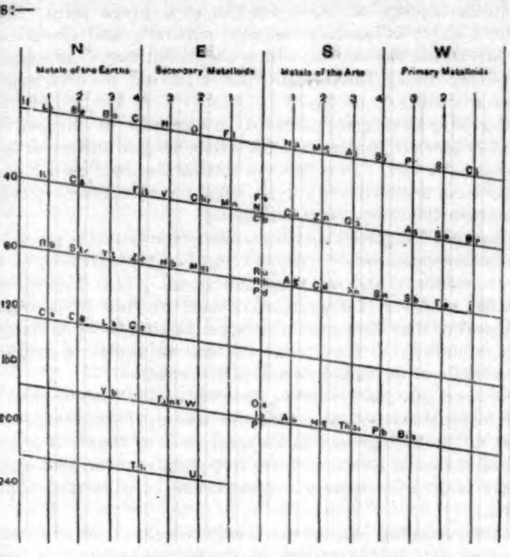
Table II.

Substance.	π	a	b^2	$27\,b^2$	$\frac{a}{27\,b^2}$
Ether	36.9	324	3249	87.723	36.9
CS_2	74.7	219	1089	29.403	74
SO_2	78.9	123	576	15.552	79
Alcohol	62.1	236	1369	36.963	63.8
Eth. Chl.	52.6	227	1600	43.200	52.5
Benzine	49.5	438	2601	70.227	62.3
Acetone	51.2	273	1936	52.272	52.2
Eth. Acet.	42.6	348	3025	81.675	42.6
Chloroform	54.9	287	1936	52.272	54.9
Eth. Form.	48.7	304	2304	62.208	48.8
Meth. Acet.	57.6	248	1521	41.067	60.3
Diethylam	38.7	355	3364	90.828	39
Nitrous oxide	37.1	74.2	376.4	10.116	73

This table shows that a varies as (volume)$^{\frac{2}{3}}$. Two substances do not agree with this theory — benzine and NO_2. This is owing to the fact that the data are given wrongly in the table from which this is copied (i.e., that in Ostwald's "Outlines of General Chemistry"). This is seen by the following facts. From the

cubic equation we find that at the critical point, π, the critical pressure $= \frac{a}{27 b^2}$. Table II. gives the results of this calculation, and it will be seen that the values for benzine and NO_2 do not coincide with the values for π. As the values of a and b were originally calculated from π, it is evident that some misprint has crept into the tables, and there is little doubt but that if the correct values for a and b were substituted, they would fall into line and that in all cases the quantity a, in Van der Waals' equation, must be taken as equal to a quantity c, which is constant for all gases, multiplied by the atomic volume to the $\frac{1}{3}$ power.

4. Electrical conductivity. As before mentioned linked atoms cannot conduct. If we examine the enclosed cube of the elements, we see that the non-conducting elements are found on sides E and W of the cube, and these are the elements whose atoms are linked or plexed. We can tell this in the following ways:—



CUBE OF THE ELEMENTS.

1st, By their low specific heats. Those who are acquainted with chemical physics will recognize this fact and the necessary deduction. Briefly, if the kinetic energies of all molecules are the same at the same temperature, then if the sulphur molecule in solid sulphur is triatomic, or has its mass three times that of one atom; then since all the $\frac{1}{2} m v^2 s$ are equal, solid sulphur will only have $\frac{1}{3}$ the specific heat it would have if the molecule were monatomic (provided that no work is spent in disassociating the molecule.)

The standard atomic heat is 6.4. The following substances have low specific heats, and are all insulators or poor conductors: Sulphur, 5.4; phosphorus, 5.4; fluorine, 5; silicon, 3.8; carbon, 1.8.

2d, By their vapor densities. If a substance has a biatomic vapor it is not likely that it will be a monatomic solid. The following substances have two or more atoms to the molecule when in the state of vapor: sulphur, iodine, bromine, chlorine, selenium, tellurium, phosphorus, arsenic. And these are all insulators or poor conductors, while mercury, cadmium, zinc, and sodium have monatomic vapors and are good conductors.

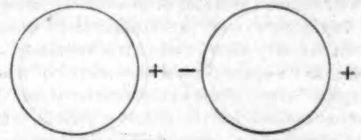
As regards metals in the allotropic state. Allotropic is a word which has been used to cover a multitude of sins. Every time an erring element goes wrong and misbehaves itself by emphasizing some of its previous peculiarities, or developes some new ones, it is stigmatized as "allotropic." For instance, we see it stated that when iron amalgam is strongly heated the iron left behind is allotropic because it takes fire in the air. But such an action does not show that any new property has been developed, it merely emphasizes a fact already well known, i.e., that iron oxidizes when exposed to air. A fine cambric needle will catch fire when held in the flame of a Bunsen burner for a second, and will continue to burn like a match after it is withdrawn. When the iron is in a finely divided state, the surface exposed is greater, and, the oxidation per unit of mass being much greater, the temperature of the iron is raised much more, thus favoring oxidation still more.

If, then, we are to use the word allotropic in this sense, we should logically speak of kindling-wood as an allotropic form of timber, for, as fire underwriters know, heavy timber is one of the most fireproof of substances. We might also speak of that form of conscience which large corporations are supposed to possess, as an allotropic conscience.

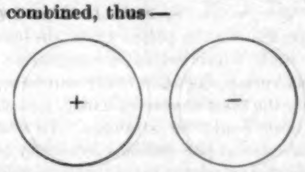
If, however, we do apply the word allotropic to such forms as Joule's iron, Cary-Lea's silver, etc., then we need another word to express the changes in the physical behavior of metals which are not due merely to the accenting of known properties but to the development of new properties, due to the joining of two or more atoms of a metal into one molecule. Polymerism might do, but it does not lend itself easily to use, and for myself I prefer to use the word plex, and to speak of diplexed iodine, triplexed sulphur, and of an element in a plexed form; though I have no doubt that if Clifford were still with us he would say that two-linked and three-linked are good enough for any honest Anglo-Saxon.

As regards the conductivity of "allotropic" elements, there is no reason to suppose that the conductivity of Joule's iron is different from that of ordinary iron. But when the elements are plexed, as we have seen above, the resistance will be much increased and the temperature sufficiently lowered, because heating increases disassociation nearly as fast as it lessens rigidity, or even in the case of those alloys or elements with negative temperature coefficients, faster.

[NOTE.—With regard to the previous paper, it may be noted that the explanation of the difference between cohesion and chemical combination, that in cohesion the atoms are charged similarly in every way except as regards position, thus —



while if any third substance short circuits the atoms they are left chemically combined, thus —



is also an explanation of a law which will probably be found true in the near future, i.e., no two substances can combine with each other without the presence of a third, thus making all chemical action the result of catalysis, plexed forms of the substances being capable of acting third substances. As regards the shortening of stretched rubber by heating, it is of course not to be supposed that the two parts of India rubber are literally contained one inside a sphere of the other, but that rubber rather resembles a tangled reel of silk embedded in jelly. If we consider any element of the jelly, and we see that it is bounded on all sides by threads of silk, and that these will act as the cell-wall of the previous paper, only "more so." The heating of rubber when stretched may be explained conversely by the compression of the jelly-substance by the cell-wall substance. R. A. F.]

THE GROOVE IN THE PETIOLE OF LEAVES.

BY AVEN NELSON, UNIVERSITY OF WYOMING, LARAMIE, WYOMING.

IN the spring of 1892, I had the pleasure of making some observations and brief studies, in conjunction with Mr. H. L. Jones, upon the origin and more particularly the function of the groove found in the petiole of many leaves, especially of Endogens.

Being at that time students in the Graduate Department of Harvard University, we laid under tribute the varied and extensive resources of the Harvard Botanic Gardens.

We first entered upon the histological study of the petiole and its groove, but soon discovered that that point of view alone would yield but meagre results: that we must depend largely upon actual experiment with plants showing this characteristic, and even more largely yet upon careful observation of the plants themselves in their habit of growth and mode of branching and the arrangement of leaves and roots on the particular plant under observation.

In order to get a starting-point it became necessary to make some guesses or suppositions as to the origin or purpose. Some of these suppositions came after a time to be so strengthened as to justify us in calling them theories, a few of which I will give with some of the facts supporting them.

In looking for the origin we do not find the groove developed as a characteristic structure earlier than in the Endogens. It is true that from the earliest differentiation of tissue into leaf we find in some instances the base of the leaf flattened and a strong suggestion of a groove as seen in some mosses, lycopods, ferns, and the bracts of the horsetails.

Finding the groove well developed in the Endogens almost without exception, and much less so in Exogens we are justified in concluding that in the Endogens there exists a necessity for such a leaf and petiole which is not found elsewhere. If, then, we can discover what this necessity is we shall, at the same time, have arrived at the origin of the peculiarity, for a plant by selection develops those structures best suited to its growth and perpetuation.

Without troubling myself at present about the reason for the difference in the habit of growth of Exogens and Endogens, but accepting these as we find them, keeping in mind always that a change in the habit of growth of one part of a plant, due to a change in surroundings, may necessitate a change in other parts as well, we will notice the habit of growth of Endogens.

Here we find plants with an unbranched stem, sometimes quite long, but usually short and often reduced to a minimum. The leaves are, as compared with the leaves of Exogens, few in number but quite large, often extraordinarily so. In these facts we can see some reasons for the grooved petiole. Like all leaves they must be attached in some way, and nature will find the most convenient way if at the same time her other purposes can be subserved. Now, where space is at a premium as in very short stemmed species or as in palms where the leaves are crowded into a terminal bud, what better arrangement than grooved flattened petioles overlapping each other can be suggested?

But it is not only the most convenient way, it is also the strongest way in which these could be attached. In a large number of plants we find the base of the petioles so closely overlapping that all are bound into so compact a mass that it would be almost impossible to pull out one without destroying the whole whorl or, I may say, the whole plant. This sheathing and overlapping of the petioles is coincident with the groove, or, I had better say, the groove is largely coincident with a sheathing base of the leaf.

So then I would say that convenience of attachment for the leaf and great strength for the plant as a whole are the first gains to be noted. As examples I may cite most palms and other Endogens with a very short stem and large leaves, or, to specify a few, Latania Borbonica, Pandanus utilis, Homalonema caerulescens, several of the Bilbergias, Crinum asiaticum, Pitcairnia hystrix, Bromelia pinguin, etc.

Before leaving this subject of strength the gain to the individual leaves by a sheathing base or grooved petiole needs to be noted.

We are all aware that from a given amount of material a stronger structure is produced if arranged in the form of a hollow cylinder than if in a solid column. Nature makes use of the hollow cylinder in grass stalks where strength and lightness is desirable, why not then, so far as possible, use the same economy in supporting those immense endogenous leaves, many of which are subjected to tremendous strain because of the long petioles necessary to carry them out into the sunlight?

As a matter of fact we do find them in all degrees from a completely sheathing base to half-cylinders, even the latter of which is greatly stronger than the same amount of material in a solid column.

Then, again, that mode of attaching the leaf gives greater strength because one side of the petiole braces the other. That could best be shown practically, yet one can easily conceive that where, for instance, the extreme margins of the petiole are attached to the stem 180° apart, each margin furnished with its fibro-vascular bundles continuous into the stem, these marginal fibro-vascular bundles act as guy ropes upon the long petioled leaf as it is swayed by the breeze.

We may further note the convenience of attachment with respect to the fibro-vascular bundles themselves. These being continuous from the leaf into the stem and the leaf attaching in a semi circle at a uniform height on the stem there is no necessity for a convergence of these bundles at a given point. But a greater number of bundles can pass naturally and directly into that part of the stem down which they continue. As examples illustrating this I would call your attention to corn and the grasses generally.

The groove having been formed in the base of the petiole it naturally persists throughout its whole length and even in the midrib of the leaf. Development in this manner, rather than a change from a grooved to a cylindrical form, represents development along the line of least resistance.

It has been suggested that the groove represents the persistance of a former condition or type and that at present the groove is merely incidental and no longer functional. This does not seem probable, however, for as noted before we find little trace in forms earlier than Endogens and again passing away in Exogens. There is nothing to show that the groove is not to-day at its highest state of development and differentiation.

It is developed, as I believe, because of the unbranched and often much shortened stem with the accompanying large leaves found in the Endogens. In Exogens, where found, it seems to perform the same functions already pointed out for Endogens, or oftener it is here merely a persistance of a former habit of growth.

In the preceding statements I believe I have pointed out the ancestral significance of the groove in the petiole. It now remains to see whether, because of a change in surroundings, this groove has secondarily taken on any new functions.

It has been suggested: 1. That the groove and axillary pockets thus formed may be regions where the absorption of water takes place. 2. That the groove guides the water to the young nascent buds in the axils and that these may absorb. 3. That the groove directs the water towards the main axis of the plant, and that in such plants the root-hair area will be found near the main axis.

If the above functions are found now to exist in some plants, I think they have been acquired secondarily and comparatively recently. The groove I consider coincident to and co-existent with the endogenous type of vegetation. Furthermore, at the time when the endogenous type was the prevailing vegetation, there was no necessity for the assumption by the petioles of the above-mentioned functions. There are reasons for believing that the regions where this type of vegetation took its rise were exceedingly well watered, and the ground, being wholly shaded by the denseness of the foliage, was at all points of nearly uniform moisture, usually nearly saturated. In fact, this is still the condition where this type of vegetation is most luxuriant.

Careful microscopic examination of the tissues and their arrangement in the groove and in the axillary pocket formed by the petiole showed essentially the same structure as on other parts of the petiole — cutinized always, sometimes as heavily as outside, usually without stomata in the pocket and few in the groove. A large number were examined, and it seems justifiable to conclude that, ordinarily, the groove is not an absorbing region.

There are, however, a few anomalous conditions and structures, the use of which is difficult to comprehend. In the Bilbergias we find the base of the petiole bearing a large number of radiately branched trichomes situated in small depressions in the epidermis. It should be said that these petioles are so arranged on the stem as

to form pockets capable of holding water, and that if these pockets are filled with water the trichomes, both outside and inside, will be submerged.

Also in Tulips the tightly-folded sheathing base is covered on the inside with a large number of thin-walled hair-like trichomes. In fact, the resemblance to root-hairs was quite close. The leaf was adapted for guiding any water that might fall upon it directly to this region of trichomes. Here it seems possible, as also in the Bilbergias, that the plants may have developed, because of a change in the conditions under which they grow, these additional absorbing structures.

A series of experiments, however, failed to give conclusive proof of this function. Several innocuous liquid stains were placed and retained for hours, and even days, in these axillary pockets, after which sections were made of various parts of the stem. In a few instances the tissues were unmistakably stained. Oftener, however, no trace of absorbed stain could be found.

Yucca, a plant of arid regions, possibly also absorbs water through the base of the petiole, since we find on that part of the petiole which is wholly buried among the petioles of the surrounding leaves a large number of stomata.

These stomata may absorb water trickling into this region without at other times subjecting the plant to dessication, as they would if found on exposed parts of the leaf.

Now as to the root-hair area. Do we find in these plants whose leaves direct the water toward the main axis that the area of root-hairs is near the axis, and, on the other hand, that where the water is drained outward it will fall near the region of greatest root activity?

I believe we do in a very large majority of cases. There are plenty of exceptions, but I believe they are exceptions and not the rule. As examples note all the grasses with fibrous roots, and many other Endogens growing from corms, bulbs, and rhizomes, from which grow out great masses of short, fibrous roots. On the other hand, note the forest trees, generally shedding the water outward and carrying the water toward if not to the root-hair area. But now I am not going to assert that the groove has been developed in order to direct the water inward, nor that the branches droop in order to carry it outward. On the contrary, if the root-hair areas are found as I have asserted, it is because these are the areas of greatest moisture, not that these have been made the areas of greatest moisture because the root-hairs existed there. The plant in sending out its roots seeks for moisture, and where that moisture and food is found in its most available form, it will develop root-hairs.

It does not seem then that the position of the root-hair area had any thing to do with the original formation of a grooved petiole, and I will again state that I believe the grooved petiole co-existent with and a necessity to the endogeneous type of vegetation.

THE CLEANSING FUNCTION OF HAIRS.

BY HENRY SEWELL, PH.D., M.D., DENVER, COLO.

THE student of animal morphology is never so happy as in the discovery of a rudimentary organ or some structure which seems a worthless burden to its possessor; for, with an unacknowledged belief in a sort of teleology, he hopes by finding the origin of the useless appendage that the tangle of phylogeny may be loosened.

The student of animal physiology, on the other hand, is never more complacent than when to an apparently useless structure or unmeaning arrangement he can attribute some function by virtue of which the body is made a more efficient machine.

An interesting example of the subservience of form to function, which the writer has never seen mentioned, is found in the arrangement of the epidermic scales which form the outermost layer of animal hairs. The buried edges of the scales point towards the root of the hair, while the free edges project obliquely in the direction of the hair end, as the shingles on a roof point to the eaves. When a hair is drawn between the thumb and forefinger, which are gently pressed upon it, it will be found that the hair glides far more easily when pulled from root to tip than in the opposite direction. When the hair is simply rolled between the thumb and finger it will gradually move parallel to its length in the direction of the hair root. These results depend altogether on the way in which the hair-scales project from the hair axis. It is at once obvious that foreign particles clinging to the hair *in situ* would find easy the passage outward towards the tip and away from the surface of the body, but exceedingly difficult the progress in the opposite direction. Every movement of the hair, especially frictional disturbance, must set up a current of foreign particles towards the hair tip. The housewife has long known by experience how much more readily a vigorous shaking cleanses a woolen garment than one made of cotton.

The sebaceous glands opening at the mouth of the hair follicle, probably play an important part in surface cleansing; for their oily secretion sticks together the particles of shed epithelium, associated with all manner of filth, in such a manner that the "hair-rakes" can, no doubt, more easily remove them.

Ludwig long ago showed that, in the same way, the mucus secreted by the surface epithelium of the stomach and intestines agglutinates the detritus which covers the mucous membrane after digestion, and so makes possible its removal by the peristaltic action. The housewife, again, uses the same principle when she sprinkles a very dusty floor before sweeping, and finds the filth to roll before her broom.

One more reference to physiological body-cleaning: It has been found that the growth of epidermic epithelium proceeds in such a way, at least in certain situations, as to remove the worn-out cells *en masse*. Thus, on the external surface of the ear-drum, the direction of growth is such that the epithelial scales progress, pushed from below, steadily from the centre of the membrane and then along the meatus to the exterior. Foreign particles lying on the epidermis are of course carried with it.

NOTES AND NEWS.

THE first annual meeting of the Ohio Academy of Science was held at Columbus on Dec. 29-30, 1892. After some formal business, such as the appointment of committees, had been attended to, the reading of papers began. The following, among others, were read during the session: The Advantages of Arzama obliquata for Laboratory Instruction, D. S. Kellicott; The Inhabitants of a Species of Gall on Wheat Plants, F. M. Webster; Some Anticlines found in the Shales of Northeastern Ohio, Geo. H. Colton; Lantern Slides without a Negative, W. G. Tight; A Few Rare Ohio Plants, Aug. D. Selby; New Plants for the Flora of Ohio, W. C. Werner; Notes on the Distribution of Some Rare Plants in Ohio, W. C. Werner; Lichens of Ohio, E. E. Bogue; Leaf Variation: Its Extent and Significance, Mrs. W. A. Kellerman; Some Insect Migrants in Ohio, F. M. Webster; The Uredineæ of Ohio, Freda Detmers; Ohio Erysipheæ, Aug. D. Selby; The Development of the Berea Stone Industry, J. H. Smith; Snow-Rollers, W. S. Ford; Note on a Nest of White Ants, O. L. Sadler and Mrs. O. L. Sadler; The Histology of the Stem of Pontederia cordata L., E. M. Wilcox; Pulmonary Fistula in a Frog, J. B. Wright; Note on a Skull Pierced by a Stone Spear-Head, E. W. Claypole. In the evening the president, Dr. E. W. Claypole, delivered the annual address, taking for his subject "Devonian Ohio, or a Passage in the Making of the State." Premising that such an address should not be one intelligible only to geologists, as the majority were not specially devoted to that science, he outlined the geological history and growth of the region from the commencement of the deposition of the Corniferous Limestone to the base of the Berea Grit. The first part of the era was a time of profound peace, when a coral sea overlay all the State. This was followed by a time of depression, when the vast beds of shale were laid down. The fishes of that era, as preserved in these shales, came in for full consideration, and their immense bony plates were illustrated by numerous drawings. The leading genera were Titanichthys, Dinichthys, and Gorgonichthys. Mr. W. K. Moorehead was appointed a committee on archæology, especially with a view to the investigation of the antiquities of Ohio, and Professor G. F. Wright was made a committee on boulders.

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SOME POINTS IN THE COMPARATIVE OSTEOLOGY OF THE TAPIR.

BY CHARLES EARLE, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.

So much has been written in the last decade on the evolution of the horse, that I think it will not be out of place to compare some of the skeletal structures of its most generalized relative, the tapir. The tapir represents in the fauna of the present day the most generalized member of the odd-toed Ungulates, and in its osteological structure we find the closest relationship with those old Eocene Perissodactyles, which are now entirely extinct. As a whole, the structure of the tapir presents us with a most generalized form, but the extreme modification of the nasal region of the skull is a modernization, as it is called. Of all the known Tapiroids of the Eocene there is none which shows this extreme specialization of the facial region of the skull for a proboscis. Cuvier in the "Ossemenes Fossiles" compares the osteology of the American and Malayan tapir in a general way, but does not treat the subject in detail.

In the present paper, I wish to speak in particular of the comparative evolution of the foot structure in the tapir. In such widely isolated forms as the American and Malayan tapir we would naturally expect to find some differences in the details of their foot-structure, and such is the case. On evolutionary ground these differences are of great interest, but I do not wish to trouble my readers with a lot of dry anatomical details, without the latter being of some interest.

As a word of introduction I would say, that the derivation of the modern digitigrade Ungulates has been from an animal with a plantigrade foot, the latter having had five complete digits. An approach to this type is seen in the Puerco genus *Periptychus*. Another point of great importance in the structure of this primitive or ancestral foot was that the various elements of which it was composed were arranged one above the other; the serial arrangement as it is called. The carpus and tarsus of the Eocene *Phenacodus* exhibits the serial order of its elements. Now in the evolution of the foot-structure of the tapir, it has departed from the serial order above described, and with this specialization has occurred a loss of lateral toes. However, the tapir has been fortunate enough to lose only one of its anterior toes, whereas the horse and rhinoceros have lost more.

When we compare the structure of the fore feet of the common Brazilian tapir (*T. Americanus*) with that of its Malayan relative, we find considerable difference in the shape and relation of the bones of the carpus. This relationship is due to the comparative specialization in the foot-structure of the one species over the other. In the American tapir the external lateral toe is very much reduced and functionless. In the living tapir this fifth digit transmits little or no weight to the ground. Co-ordinated with the reduction of the fifth digit in this species is the growth of the median digit of the manus. Another co-ordination of the reduced size of the fifth digit in the American tapir is the large articulation of the unciform bone with the lunar. The lunar has also no contact, or a very small one, with the magnum anteriorly.

It has been observed in the evolution of the foot-structure of the Perissodactyles that in the earlier and heavier forms the fifth digit of the manus is always largely developed, and with the large size of this digit is the comparatively small size of the median. In this respect, these earlier forms approach more nearly in their foot-structure the even-toed Ungulates (*Artiodactyla*). Again, in these less specialized forms the long axis of the unciform bone is always horizontal.

The position of the unciform is co-ordinated with the large size of the fifth toe; and as a consequence there is a smaller contact between it and the lunar, than in the later and more specialized forms. We observe then, as a rule, that as the unciform begins to rotate upwards and assume the vertical position, the external lateral digit becomes more and more reduced in size.

Another correlation in reference to the large size of the lateral digit is the nearly subequal distal facets of the lunar, an adaptation which is for the equal transmission of the weight of the foot on both sides of the median axis. The magnum is also much depressed and broad in those heavy and more ancient forms.

Turning to the manus of the Malayan tapir, we find the external lateral toe more developed than in the American form. There is also less difference in size between the latter and the median toe. The lunar has a large contact with the magnum anteriorly; the latter bone being broader than in the American form. That less displacement has taken place in the manus of the Malayan tapir is shown from the fact that the unciform and scaphoid bones are widely separated, whereas in the American tapir these bones nearly touch each other. The approach of these latter bones takes place with the reduction of the fifth toe until in some species of rhinoceros they are nearly in contact.

As for the tarsus we observe that the hind foot of the Malayan tapir is broader and heavier than in the American species. A very important difference between the structure of the pes in these two forms is that in the Malayan species both the lateral metatarsals articulate with the ectocuneiform, whereas in the Brazilian form only the internal metatarsal touches this podial element.

In conclusion, we see from the above characters that the manus of the Brazilian tapir is considerably more specialized than that of the Malayan tapir; on the other hand, the pes of the former is not so much modified in structure as that of the latter species. In other details of the skeleton of the tapir, I am not aware that many differences exist. In relation to the lumbar vertebral articulations, I would observe that they are very simple and articulate by plane surfaces. In general, the Eocene Perissodactyles (*Hyracotherium*, *Hyrachyus*) have embracing vertebral articulations.

THE SPEECH OF CHILDREN.

BY A. STEVENSON, ARTHUR, ONTARIO, CANADA.

THE term speech ordinarily signifies articulate vocal utterance in conventional forms, intentionally expressive of feelings or ideas. In treating of speech as a product of intelligence too much is sometimes made of the articulation factor. For articulation is not characteristic of man alone, and among the lower orders, the elephant and the dog, which do not articulate, are more intelligent than the articulating parrots. Moreover, the child, before he can articulate, employs inarticulate utterance with intentional and striking expressiveness.

The first cry of a child, whether or not we call it a rudimentary form of speech, is certainly a vocal utterance strongly expressive of feeling. Though the element of intention is absent for several months, yet there is a considerable variety of expressive quality in the child's cries during this time. This organism, indeed, is like a wind-harp responding in various tones to diverse sense-impressions.

These early cries are expressive simply of pain or distress, and their expressiveness consists partly in tone and party in intensity.

They vary in tone according to the nature of the exciting cause, and in intensity according to its degree. The range of expression is exceedingly limited, for several months being chiefly restricted within the bounds of physical suffering. Here, however, some mothers and some medical men find valuable assistance in the diagnosis of physiological disturbances.

But the young infant's cries do not always express physical feeling merely. There soon appears a quality, which, after very little development, comes to be distinguished as mental. The child H., on the eighth day after birth, was much startled by the sound of a bottle falling to the floor. She made no outcry on this occasion, but on the twentieth day a similar noise drew from her well-marked tones of fear. At the same time a general tremor was exhibited by her, such as accompanies terror in older persons. It is not to be wondered that there should be expressive emotional quality in the cries of such young children when we observe the well-marked variations in facial expression even at this early period. Physical pain shows itself in the countenance from the very first. On the fifth day H. undoubtedly manifested disgust in this way at the taste of a nauseous medicine, but her countenance immediately resumed the normal expression when a pleasant medicine was substituted. On the seventeenth day she showed great distress at the sharp and screaming cries of another child. On the thirty second day she smiled at her mother in response to fondling and caresses. On the thirty-eighth day her countenance plainly expressed wonder when she was taken into a strange room.

The young infant's cries of discomfort soon become differentiated, and among the specific utterances that emerge the cry or call of desire appears early. It is difficult to define the subtle beginnings of this form of utterance; it seemed plain to me in one case in the second month; there is no doubt that it appeared in the tones of another child in the sixth month.

On the thirtieth day the child M. gave utterance to a sound indicative of comfort and satisfaction. By the forty-eighth day this sound assumed distinct form as a low, soft oo. During the nights of the forty-fifth and the forty-ninth days M. laughed heartily in her sleep with a sound that, except for its softness, certainly resembled very much the adult "ha, ha, ha."

This last utterance, perhaps, shows merely one form of vocal capacity at the time, but it seems reasonable to assume that the other utterances described, or most of them at least, possess psychical significance in some degree. It is not sufficient to speak of such sounds as mere non-significant products of muscular movements, reflex, instinctive, or spontaneous. They are really the crude raw material of the vocal element in conventional speech. They soon grow into the sounds of language, which is the joint product of mental and bodily faculties and activities.

Just at this stage the child is in a fit condition to begin any language. These first utterances belong to the common mother-tongue of the race. What particular form of speech the child ultimately learns depends altogether on his environment. He begins wildly and indiscriminately with various sounds, but in course of time some, lacking the stimulus of example and encouragement from those about the child, fall into disuse, while other sounds, under that stimulus, are drawn out and cultivated. The speech of the adult is the result of a long evolution under the influence of environment and unconscious selection.

The observer of child language must note development along two lines, in the mind and in the vocal organs. We will follow the latter chiefly. The inarticulate cries and calls of children soon come to be interspersed with articulate sounds. The easier vowels come early. The child M. uttered freely and clearly ah and oo early in the third month. These sounds appeared spontaneously, but could afterwards be evoked in imitation.

Of the consonantal sounds, the first to appear in the cases of O. and M. were b, f, p, d, t, m, n, ng, h, k, and g guttural as an initial. O. could make these sounds in the tenth month, but for several months afterwards he could pronounce them only singly or in easy combinations. Slowly, and with greater or less difficulty, the others were acquired. At two years O. could pronounce the vowel and dipthong sounds except oi and ew, and all the consonants except th, v, and the trilled l and r. He still had considerable difficulty with the guttural g as a final, for which he substituted d until his fourth year. For k final he invariably used t for about the same period; v was sounded b for a while, th was entirely omitted as a thick sound, as a thin sound f or s was substituted until the fourth year. Various consonantal combinations were especially slow in being perfected, as ks and kw, and all combinations with s as initial. l and r gave trouble until the fifth year. At first they were omitted entirely in any situation, then y and w began to appear respectively as initial substitutes, and the preceding vowels began to acquire breadth and prolongation when l and r were medials or finals. The child M., however, acquired r final early in the second year.

The mispronunciations of children may seem arbitrary and altogether irregular to the casual observer, but in reality nearly all of them can be readily classified and arranged under law, the same law that appears in the broken speech of foreigners attempting English, and indeed in the history of the changes that have come over the sounds of English words themselves. A child is a foreigner learning the language, and he pronounces the easier sounds rather than the difficult. The omissions and substitutions of children represent the difficulties in sounding the vocal elements and combinations of our speech — difficulties that adults struggled with and overcame at so early an age that they do not recognize them as difficulties.

In the speech of the child O. during his first four years the following classes of consonantal substitutions regularly appeared.

First classifying the sounds according to the organ of articulation: —

	Sound attempted.	Sound made.	Example.	Comparison.
Labials.	f	p	Epple = Effle	(L) pater, father
	wh	f	file = while	cough
	v	f	ofer = over	five, fifty
	v	b	ballse = valise	have (O.E), habban
	p	m	moon = spoon	Polly, Molly
	m	p	Pata = Martha	Patty, Mattie
Dentals.	d	n	ness = dress	
	t	n	nats = tacks	
	th	t	cot = cloth	
	t	d	bodde = bottle	(L) duo, two

Second. classifying the sounds according to their duration in utterance: —

Spirants (sharp).	th	s	sissle = thistle	loves, loveth
	f	h	hind = find	laugh
	th	f	fumb = thumb	Fedor, Theodore
Mutes (sharp).	k	t	fots = fox	
(flat).	g	d	pid = pig	
	g	j	jive = give	joy, (L) gaudere
	b	j	janana = banana	
	d	j	jit = drink	
(nasal).	n	m	timy = tiny	lime, linden

Besides these there were several other regular permutations, which do not fall into any of the above classes. I have not observed any interchanges in the use of gutturals, palatals, or sibilants, or in the flat spirants. One child I knew of regularly interchanged the trilled spirants, as in "I rost my ling" (= I lost my ring).

The speech of children shows all the features which, in standard language, we consider as the product of phonetic decay in the various forms of aphœresis, syncope, and apocope. The omission in both cases is due to the same cause, namely, the excessive effort that would be required to articulate the sounds.

As far as my observation goes, children rarely add new elements in sounding words. Transposition, however, is not uncommon; O. regularly said kit for tick and krunt for trunk.

The ability to discriminate vocal tones, which infants possess in a remarkable degree, is a potent factor in the acquisition of language. This ability is manifested very early, showing itself in looks of distress or outcries even, in response to harsh language, and in a return to placidity when softer tones follow. Such manifestations are, of course, instinctive, and are precisely of the same nature as the exhibition of terror referred to as made by H. on the eighth day of her life at the falling of a bottle to the floor. Again, the child M. in her tenth month was trained to keep away from a hot-air register by the use of the simple word "burn," spoken to her several times with considerable intensity of warning in the tones. A soothing effect is produced on children not only by soft and musical sounds, but by sibilation,

either by the voice or by such means as the rustling of paper. Almost any novel sound induces temporary distraction from crying.

Imitation plays an all-important part in the acquisition of conventional speech. In the case of O., the faculty of imitation appeared first in manual actions and during the tenth month. Vocal imitation was first observed in the thirteenth month, when, under the stimulus of the shouting of other children at play, he, also, began to shout vociferously. Shortly afterwards he began, under instruction, to imitate the sound of a watch's "tick-tick." But in this instance, and others which followed, there is no argument for an onomatopoetic origin of language, for in no case did the child originate the imitation. He merely imitated an imitation first made by his parents. From this period imitation showed itself frequently, and the child was delighted with his successful attempts; the delight was increased when these attempts were appreciated and reproduced by those about him.

It is scarcely necessary to mention that infants understand a considerable range of language long before they can speak. A child readily learns a few words for simple objects or actions before he is a year old, and some children can be taught to understand "No" as a sign of prohibition as early as the eighth month. This last is a similar development of intelligence to that early gained from an experience of pain resulting from contact with injurious objects. In his seventh month O. was accidentally allowed to touch a hot lamp chimney, and, being burnt, he would always afterwards draw back on being brought near a lamp.

We may sometimes hear it said that the first words uttered by children are nouns, in respect to grammatical function. The truth is that, though an infant's first words are commonly such as are used by us in nominal relations, yet in the infant's speech these words are not nouns, but equivalent to whole sentences. When a very young child says "water," he is not using that word merely as the name of the object so denoted by us, but with the value of an assertion something like "I want water," or "There is water," the distinction in meaning between the two expressions being shown by the child's tone of utterance.

There is no form of linguistic study more instructive and interesting than the observation of the successive and correlative processes in the growth of such interjectional expressions as this into the various and complex forms of conventional sentences. With the child O. some of the various steps along the straight line of development from the single word to the full, simple sentence were as follows: "Water," "drink water," "want a drink of water," "baby wants a drink of water," or "him wants a drink of water," "I want a drink; *baby* wants a drink of water," "I want a drink of water." No instruction was given the child in the case, and it took him more than two years to develop the conventional sentence after he had begun to use the word "water." The natural difficulty which children have in acquiring the use of the personal "I" appears in the foregoing examples. Even after O. began to use "I" as a name for himself he seemed to think it necessary to explain or justify the word to himself by repeating the statement and using instead of "I" the name "baby" or "Oscar." Occasionally he used the noun first and repeated, as in "Baby want a drink, I want a drink."

Similarly, the child was long in learning to use the objective personal "me." The earlier mode of expression was to employ the name baby, as "Papa, carry baby." Before reaching the regular use of the possessive "my," O. always expressed this relation by "its," as in "Papa, take its hand," "Mamma, wipe its eyes." Thus until nearly three years of age, the child apparently regarded himself only as object and not at all as subject. Other curious forms of expression in habitual use shortly after this were such as "I am going down, me," "I'm going home, I'm are."

Notional words were acquired before those indicating relations, and of the latter the simpler and more notional were first acquired. Vocabulary and expression developed considerably without the use of the verb "to be." Interrogative pronouns, interrogative adjectives and adverbs came into use early, the relative or conjunctive pronouns much later — nearly two years. Adverbs came before prepositions. At first the prepositional function was served by placing the related words in juxtaposition, as "See old man (with) head down." In this sentence note also the omission of the comparatively noticnless word "the."

Color names caused great difficulty, their proper application depending, of course, on a considerable development of the perceptive powers. During the early part of his third year O. used "blue" freely, but he applied it to any striking color, as to a white horse and a red book. Similarly with number names, O. could not use the simpler names properly beyond one and two until nearly his fourth year. Any number beyond two he called "nine." "No" was easily acquired; "yes" cost a great deal of effort, not in pronunciation, but in comprehension and application. At three years of age, to give an affirmative answer he would repeat the question in the form of an affirmation, or reply by "it is" or "it does." Then, after beginning to use "yes," it was applied irregularly, as in answering the question, "Will you do that any more?" O. said, "Yes, I won't." This is not a self-contradictory expression, as it would superficially seem. The child meant by "yes" that he was willing to obey, and the "I won't" defined the form the obedience would take.

The strength of the linguistic instinct in children is shown by the remarkable shifts they will make to find forms of expression for their perceptions or feelings. An examination of these shifts will show that the energy of the child manifests itself along precisely the same lines as have been taken by the languages of the races of mankind towards their ultimate forms. Thus, lacking the work "wide," O. said, "Open the door loud," extending the meaning of the word "loud" precisely as we do when we apply it colloquially to colors. So, too, he called a raccoon a "cat," just as we speak of "plumes" of horse-hair. Other illustrations I have without number, but will add only a few. "I have a headache in my neck," "There's a boat swimming," "Mamma, you never cut the toe-nails off my fingers." "Cows eats drinks of water, cows do," "I broked it (cp. wept)," "He goed," "Papa's gooder than you," "Papa can the see (i.e., light) come in here," "Which would you rather have, Mary *and* Rhoda?" "Papa's got *that* coat on," (i.e., a new coat). In the lack of a knowledge of negative forms, O. used some curious expressions. Thus, not wanting me to go out, he said, "Papa, come in; papa, stay home;" again, not wanting his coat taken off after being out, he said, "Put baby's coat on."

The most common means by which infants enlarge their powers of expression is by the metaphorical extension of terms already known, as where O. called a piece of fur "kitty." Now this ability to use words metaphorically implies the possession of the power of abstraction in some rude degree, for metaphor-forming is a mode of abstraction. It is a remarkable thing that very young children can form these abstractions. Thus O., at the age of eighteen months, having learned the name knee from a limb in a bent position, afterwards called his mother's chin "knee," and presently applied the same term to the projecting corner of a pillow. A more striking instance occurred shortly afterwards. Being a delicate child, he was just then at the stage of beginning to stand alone. He had been frequently told to "stand up like a man." The first time he tried this feat with entire success he said "man!" with much self-approbation. Within a few days he applied the same term to his doll when standing upright, and also to a long, narrow box when set upon end. All this time he was perfectly familiar with the common uses of the names man, doll, and box. Evidently, then, in the special cases noted, he was using the term man in the sense of "the upright thing," a considerable abstraction for an infant under two years.

Finally, children invent entirely new words. A few of O.'s original were "oüah" = water, "ōbō" = music, "gladdies" = dandelion flowers, "aneen" = wagon. The last word may be a case of aphœresis and substitution, but it seems hardly likely. The others are inexplicable, except as pure inventions. I know of two cases where a pair of children, besides acquiring their mother-tongue, invented a full vocabulary entirely unintelligible to any one but themselves. It is on the observation of such cases as these that Mr. Horatio Hale has very reasonably based his theory that the closest of blood relationship may exist between tribes or races of people whose languages differ in every particular.

THE GENESEE RIVER.

BY REV. BROWNELL ROGERS, A.M., CONQUEST, N.Y.

THE Genesee River rises in Potter County, Pa., about seven miles south of the State line. The average elevation of the highest hills in this county is not far from twenty five hundred feet. The valley of the Genesee reaches southward between the basins of the Susquehanna, on the east, and of the Chautauqua Allegheny, on the west. The water-shed between these three basins lies in the townships of Allegheny and Ulysses.

The river flows north-northwest into Allegheny County, New York, to the town of Caneadea, where its direction changes to north-northeast. This direction is held until the river reaches Lake Ontario. The total fall is about twenty-two hundred feet. Its entire length is not far from one hundred miles, but flowing so nearly northward it cuts across all the formations of the New York system from the Catskills to the Medina sandstone, these formations in this part of the State having a nearly uniform east and west strike. Yet, notwithstanding, there are but two localities where these formations are generally exposed, viz., at Portage and at Rochester. True, there are a few other places where the rock is uncovered, as at Mapes, and at Belmont, Allegheny County, New York, but these are only limited exposures, and do not at all compare with the gorges at Portage and at Rochester. It is this fact that makes the river such an interesting study; for these two gorges — the one at Portage about three miles in length, and the one at Rochester about seven — are post glacial; the remainder of the course of the river being in a pre-glacial valley, which is nearly filled with drift. This old valley was several hundred feet deeper than at present, for the drift has been penetrated at various places two, three, and even four hundred feet before the bed-rock was reached, while on the hills, either side of the river, rock is struck a hundred feet or more above the present level of the water. Indeed, many of the tributary creeks have uncovered the native rock for some distance back from the river.

During the glacial epoch this old valley was undoubtedly filled with ice, for the terminal moraine forms the water-shed of Potter County. During the retreat of the ice, halts were made in at least three different places, allowing the accumulation of drift in greater quantities than elsewhere, thus damming up the already nearly-filled valley.

The first of these dams is about eight miles north of the State line, in the town of Willing. It was not so high, though, but, on the further retreat of the ice northward, the water easily found a way over the obstruction. This was on the western end of the dam, consequently this end has been almost entirely washed away. There are remnants, however, on the side of the valley at an elevation corresponding with the eastern end, which is left almost entire The second great glacial dam is at Portage. Here the drift formed so complete a barrier that the river was turned out of its course. But, instead of turning back again and flowing southward as the Allegheny River did, the Genesee was simply turned to the west, and re-entered its vallew below the dam. In plunging over the precipice, back into the old channel, strata of various degrees of hardness were exposed, the erosion of which has resulted in the formation of the present cañon, with its series of three water-falls. At the upper falls the walls of the gorge are two hundred and fifty feet high. Here the river makes a perpendicular fall of sixty feet; half a mile below, a perpendicular fall of one hundred and ten feet; and one and a half miles farther down, a broken fall of eighty feet. The summit rock at the lower falls being so soft, many changes have been produced in the falls during the last eighty years. A little south of Rochester the valley was again so completely filled as to turn the river out of its course, and again it turned to the west, cutting the gorge below the city, and north of the outcrop of the hard Niagara limestone which forms the summit of the falls at the head of the gorge. The depression occupied by Irondequoit Bay is the mouth of the old valley where it emerged from the Ontario plateau, but the valley itself is traced far out into the lake, where it opened into the old Erigan River. Had the Genesee valley not been so completely filled up throughout its entire length, we undoubtedly would have had another lake similar to Seneca and Cayuga Lakes, all of these depressions being the results of preglacial erosion. Sodus Bay and Fair Haven sustaining the same relation to these depressions as Irondequoit does to the valley of the Genesee.

ODDITIES IN BIRD LIFE.

BY C. W. SWALLOW, WILLSBURGH, OREGON.

The water ouzel (*Cinclus mexicanus*) is a very peculiar specimen of the feathered race. Here we have a bird that, from its habits, long legs and teetering motion, may easily be mistaken for a sandpiper. It may almost be called duck-like, as it is so much at home in the water, wading, swimming and diving with ease, and even walking on the bottom under water in search of food. From its shape and song it is somewhat wren-like; then again, from its bill, its song and some other points, it is quite thrush-like. The bird is not especially noted for its musical ability, yet when its sweet trills and warbles are heard in the wild forest near some rocky stream, where song-birds are rare, it is certainly charming to one that loves bird notes.

The ouzel, or American dipper, as it is sometimes called, is a western bird, found along the mountain streams between the Rocky Mountains and the Pacific coast. The birds are bluish-slate in color, darkest on top of head, back and wings. Tail nearly black. The winter plumage and young have the feathers of the throat and underparts and some of the wing feathers white-tipped, giving some specimens the appearance of being quite gray. These odd birds are about 7 inches long, with 11 inches extent of wings; wing, 3.5 inches; tail, 2 inches; tarsus, 1.1 inch; bill, .7 inch, horn-blue, yellowish at base; feet and legs yellowish. The nest, placed by or under the upturned roots of a tree or an overhanging rock or like situation, is a well-made, dome-like structure of moss and rootlets, with the entrance on one side. One nest that I examined had the entrance nearly concealed by a swinging door of moss, evidently placed there for that purpose. They are said to lay about five pure white eggs.

Perhaps one of the most odd of American birds, in habits as well as appearance, is the evening grosbeak (*Coccothraustes vespertina*). Although seemingly very widely distributed, it being reported from the New England States to Oregon and from Mexico to Canada, yet little if anything seems to be known of its breeding range and habits. Last winter, 1891 and 1892, it was quite a common bird in the vicinity of Portland, Oregon. I often observed a flock of about a score which came to a certain locality nearly every morning for a number of weeks to feed on the buds of the vine maple. I noted them from December, 1891, until April 25, 1892. This winter I have failed to see or hear one in the same localities, although it has been a much more severe winter, and would naturally lead one to expect northern birds to be more abundant than last winter, which was remarkably mild.

These birds utter a clear, bell-like chip, when flying, and occasionally when on trees; it seems to be a call note. The largest specimen I have measures as follows: Length, 8 inches; extent of wings, 13.85; wing, 4.5; tail, 3; tarsus, .75; middle toe with claw, .95; hind toe with claw, .65. They have a very heavy, cone-shaped, greenish-yellow beak about .8 inches long, by .6 broad, and .65 deep at base. With their odd colors of yellow, black and white, these birds may remind one of the setting sun, night and snow. They have a black crown patch, nearly enclosed by yellow on forehead and stripes over the eyes running back to the nape; a few black feathers at base of bill; neck, sides of head and throat brownish-olive, shading into yellow on the rump and underparts; wings and tail black; secondary coverts and some of the secondaries white, producing a large white blotch on each wing; under tail coverts yellow; feet and claws light brown; closed wings reaching to within about one-half inch of end of tail. The winter habits of the bird seem to be very much like the pine grosbeak (*Pinicola enucleator*), which is quite common in the eastern States some winters.

Another species that would be included as oddities is the chats (*Icteria*), represented in the eastern States by (*Icteria virens*)

yellow-breasted chat, and in the Pacific coast by (*I. v. longicauda*), long tailed chat. The western variety can hardly be distinguished from the eastern except by the longer tail and perhaps brighter colors. These birds are about 7 inches or a little more in length, having an extent of wings of 9.5 inches; wing a little more than 3 inches, the tail of the western bird being about the same length; bill, .65 inch long. They are slaty-brown on the head, neck and back; wings and tail brown, tinged with yellow; throat and breast bright yellow; underparts brownish-white; yellow of the throat bordered with white; a few white feathers about the eyes, and a faint light stripe from nostril to eye. They build quite a bulky nest in bushes or briars near the ground, and lay from four to six white eggs, spotted with brown. As a songster, for variety and execution, I think they are second only to the mocking bird in Oregon; but in the eastern States I do not think they can equal the brown thrasher or catbird.

In the breeding season the chats have a peculiar habit of flying up and dropping down nearly straight, beating the air with their wings incessantly. Occasionally they will remain almost stationary in the air for several minutes, beating the air with their wings and singing. At times they flap their wings so as to be heard some distance away.

A curiosity in the owl family is the pygmy owl. One variety (*Glaucidium gnoma*) is quite often seen in Oregon. They are well named pygmies, as they are only about 7.25 inches in length and 14.5 in extent of wings; tail, 2.85, of twelve feathers; bill, greenish-yellow with lighter tip; feet and claws brownish-black. This little owl appears very much like a miniature barred owl (*Syrnium nebulosum*), as it has a smooth head with no ear tufts, and is marked much like the barred owl, being of a slaty-brown, thickly barred and spotted with white, darkest on the wings and back, lighter on the underparts. This little owl I think is more of a day-bird than most of the family, as it may quite often be seen on cloudy days out hunting for mice and small birds, or even moths and insects, which I think sometimes form part of its food. It no doubt breeds in hollow trees, but I have never found its nest.

TELEPHONING BY INDUCTION.

BY G. H. BRYAN, M.A., ST. PETER'S COLLEGE, CAMBRIDGE, ENGLAND.

THE wonderful revelations dealt out to an admiring public by some of our newspapers under such headings as "Science Notes" often afford infinite amusement to the initiated. Some recent experiments of Mr. W. H. Preece, F.R.S., on induction currents, have found their way into some of these collections of information in a form which makes them appear little short of miraculous. According to some accounts, Mr. Preece has solved the problem of "telephoning without wires." He had only to speak the word (so we are told) and the electric fluid *leapt across* the three miles of sea which separates the island of Flat Holm, in the Bristol Channel, England, from the mainland, and delivered its message with unerring accuracy into the telephone placed there for its reception. On reading such accounts as this the British public will exclaim, Oh! with a mixture of awe and admiration, and half a dozen "paradox mongers" will build up unintelligible theories of "the electric fluid and the way it radiates through the ether" or something of the kind — showing that Maxwell and Faraday are *wrong* and they themselves are *right*. Those, however, who know anything about electricity will smile when they see what impossibilities the presiding genius of the British Postoffice Telegraphs is credited with performing. In the first place they will know that either telegraphing or telephoning without wires is still an impossibility. Wires there must be, and the wires at the transmitting and receiving stations must form circuits enclosing a considerable area, but the important feature of the experiments is that the two different sets of wires may be some miles apart without any wire connecting them. Then, again, the idea that the "electric fluid" can jump across through three miles of air like a flash of lightning is absurd. What really happens is that every time that a current is passed through one circuit a current is "induced" in the other circuit, and when the current in the first circuit is stopped an "induced" current flows round the second circuit in the reverse direction to what it did before. This is the well-known principle of electro-magnetic induction, which has given rise to the induction coil, the dynamo, and indeed to most of our modern applications of electricity. The remarkable thing about the present experiments is that they show that this "induction" can not only make itself felt at such great distances, but can actually be utilized to transmit telephonic messages. At present we can only speculate as to the way this "inducing action" takes place, all that we can assert definitely is that *no* electricity passes from one circuit to the other. Even if we regard the action as magnetic, the "lines of magnetic force" do not go from one wire to the other, on the contrary they encircle the wires and do not anywhere terminate on a wire. Again, so far from the action travelling with unerring accuracy in any particular direction, the same message would be transmitted to a receiving apparatus placed anywhere in the neighborhood, provided that it was furnished with a sufficiently large circuit of wire, so that if several transmitting apparatus were in use at the same time in any particular neighborhood, the various messages would get confused.

Scientific discoveries such as this appear to be comparatively simple matters on paper, but they are usually the outcome of many years of patient experimenting. It is more than six years since Mr. Preece described some similar experiments made with the telegraph wires running up the northeast and northwest coasts of England respectively. In these experiments, however, the primary current was produced by means of a powerful dynamo, but the induced current right over the other side of England was sufficient to produce a sound "very like a wail" in the telephone employed for its detection.

Feb. 10, 1892.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The So-Called "Cache Implements."

THERE has recently crept into archæological literature an unfortunate, because misleading, term for a well-known form of chipped-stone tool or weapon, that of "cache implement." This name has been suggested, on the ground of the erroneous assumption, that long, narrow blades of jasper, argillite, and other flakable stone were only to be found in "caches" or deposits, and then, continuing the argument, because so found, they were unfinished objects, and in time were to be disinterred and converted, by further chipping, into knives, spear-heads, and, possibly, arrow-points. There is not a scintilla of truth in this, so far as any living man now knows. It fits admirably, however, with a plausible theory by a coterie who have failed to make any important archæological discovery, and so is one of their mainstays in proving the modernity of America's native people; something that must be *proved* at all hazards; or, if not demonstrated, foisted upon the unthinking to secure the scientific prominence of a few archæological mugwumps.

When we examine a series of these "cache" implements, it will be seen that they are not too long, too broad, or too thick to be used as weapons or domestic implements, but lacking any evidence of a notched or narrowed base appear unavailable so far as the matter of attaching a handle thereto; *ergo*, an *un-handled* implement being an impossibility, they are unfinished. If, however, the reader will refer to "Remarks upon Chipped Stone Implements" (Bulletin of the Essex Institute, vol xv., 1883) he will find there pictured just such objects as I refer to, with short wooden handles secured by a "tenacious substance probably obtained from the cactus." Now, the Delaware Indians made a most excellent glue by boiling together cherry gum and fish-bones, and so could as readily have secured handles to these plain blades, and, considering how frequently single whole specimens and broken ones are found on village sites, it is clearly obvious that they were in frequent use.

Again, such blades, measuring usually five or six inches in length, by two in width, are not the only objects found buried in large numbers. Small leaf-shaped knives are found, often as many as one hundred together; arrow-points of various patterns have been unearthed, as well as grooved axes, celts, notched-pebbles or net sinkers, and even "ceremonial objects." Certainly not one of these can be called "unfinished." It is confusing to call any one form of stone weapon or tool a "cache implement." It would be just as logical to call the specie hoarded in treasury vaults something different from the coin in circulation.

If, to return to the large blades, they cannot come under the category of unfinished objects, does this not strike a blow at the cunning inferences drawn from recent studies of quarries, where the Indian gathered his material for implement making? The various grades supposed to lead from the raw material to the finished product is a lovely picture as drawn by pen and pencil, but in truth fails to be reproduced in nature. It is but a fancy landscape, the like of which the sun never shone upon. A picture that is so seductive as to convince the unwary, but in truth befogs the onlooker; a picture that makes essay writing a pleasant pastime, but —?

The pre-history of man in the Delaware Valley is not to be read by calling large stone blades unfinished, and the ruder forms scattered in the gravel the refuse arising in manufacturing the former. If this were true, there would be less of a problem to solve, but even then there would be as many difficulties in the way of accepting the Indian's modernity and in denying the palæolithicity of such objects as have that import in other countries.

When Holmes shall drive the fog away
That now enwraps the scene,
And in the light of later day
He stands with smile serene,
And points to how in modern time
The red man came equipped
With every blessing of the clime,
From elsewhere newly shipped;
We can but hope he'll name the date
When first upon the strand
This red man stood with heart elate,
And where he chanced to land.
Then, noble efforts nobly made,
Before he seeks a rest
Point out how far is *truth* displayed,
And just how far he guessed.

CHARLES C. ABBOTT, M.D.

Museum of American Archæology, University of Pennsylvania, Philadelphia.

The Largest Trees in the World.

A RECENT article in *Science* (No. 523, Feb. 10, 1893, p. 76) repeats the old idea, which has been frequently refuted, that the *Sequoia gigantia*, or Big Tree of California is the largest tree known. It has been shown many times that these trees are surpassed in both height and girth by the gum trees of Australasia. A large number of species are known, and many of them are mentioned in Baron von Mueller's "Extra Tropical Plants," recently reviewed in these columns. An extract from this book will be of interest as giving the dimensions of some of these immense trees. Of *Eucalyptus amygdalina* it is said:—

"In sheltered, springy, forest-glens attaining exceptionally to a height of over 400 feet, there forming a smooth stem and broad leaves, producing also seedlings of a foliage different from the ordinary form of *E. amygdalina*, which occurs in more open country, and has small narrow leaves and a rough brownish bark. The former species or variety, which has been called *Eucalyptus regnans*, represents probably the loftiest tree on the globe. Mr. J. Rollo of Yarragon measured a tree which was 410 feet high. Another tree in the Cape Otway ranges was found to be 415 feet high and 15 feet in diameter where cut in felling, at a considerable height above the ground. Another tree measured 69 feet in circumference at the base of the stem; at 12 feet from the ground it had a diameter of 14 feet; at 78 feet a diameter of 9 feet; at 144 feet a diameter of 8 feet, and at 210 feet a diameter of 5 feet. [Thus, at a height in the air exceeding the height of almost every North American forest tree, this specimen had a diameter equal to most of our largest forest trees at the ground.] Other trees are known with a stem-circumference of 66 feet at 5 feet from the ground. Prof. Wilson and Colonel Ellery obtained at Mount Sabine a measurement of 21 feet 8 inches in diameter of a stem, where cut, the length being 380 feet. Colonel Ellery had repeatedly reports of trees seven axe-handles in diameter, and he met a tree on Mount Disappointment with a stem diameter of 33 feet at about 4 feet from the ground." Other species also attain enormous size. *Eucalyptus diversicolor* is known to grow 400 feet high, and trees have been measured 300 feet long without a branch! Boards 12 feet wide can frequently be obtained. *E. globulus* grows 300 feet high and furnishes ship keels 120 feet long. *E. obliqua* also attains 300 feet in height and 10 feet in diameter. A note in a recent number of *Garden and Forest* mentions a tree in Victoria 471 feet in height.

The colossal size of the trees of this genus is not the only peculiar feature they possess. Some are of exceedingly rapid growth, and are at the same time very durable. *Eucalyptus amygdalina*, for example, grew to a height of 50 feet in 8 years in the south of France. *E. citriodora* grew 20 feet high in 2 years in a district subject to protracted drought; and a trunk 40 feet long and 20 inches in diameter only broke after a flexion of 17 inches, under a pressure of 49 tons. *E. corymbosa* is very durable, fence posts that had been in the ground for 40 years showing hardly any decay. *E. globulus* grew 60 feet high in 11 years in California, and in Florida 40 feet in 4 years, with a stem a foot in diameter. The writer has seen trees in California, two years after planting the seed, 20 feet high; and the wood, although easily cut when green, becomes almost as hard as iron when dry. In Guatemala it grew 120 feet in 12 years and had a stem diameter of 9 feet. Railway sleepers made of *E. leucoxylon* were quite sound after being laid 24 years. Piles driven for a whaling jetty in 1834 were taken out in 1877 perfectly sound, although the water swarmed with Teredo. This was *E. marginata*. Still more remarkable is the fact that some species withstand excessive heat and also a considerable cold. *E. microtheca*, for example, resists a temperature of 18° F. in France and 154° F. in central Australia. Besides serving as a timber tree, many species of *Eucalyptus* are used medicinally, producing a volatile oil very useful in treating various infectious diseases, like scarlet fever, especially when applied externally. Grown in malarious districts, they possess the power of purifying the air. Altogether, the genus may be classed as one of the most remarkable in the whole world.

JOSEPH F. JAMES, M.Sc.

Washington, D.C., Feb. 24.

Fern Frost.

AT Greensburg, Indiana, on the morning of Jan. 24, the trees and fences were fringed with a beautiful feathery frost. It was really a snow frost, but the flakes or aggregations of crystals were fern-shaped instead of star-shaped. Every branch of a tree or wire of a fence bore a line of snow-frost on its south side, making a downy fringe of one-half inch, or more, in length. A weeping willow tree and a fence of wire-netting were most striking in this decoration.

The barometer was 30.15; temperature, 16; moisture about 90; the air seemed perfectly still, but on wetting the finger and holding it above the head the north side was cooled, showing that there was some movement and from what direction. This showed why the fern frost was arranged on the south side of twigs and other objects. There could have been no perceptible wind during the formation of this fern frost, for I could not touch a branch or twig without causing much of this fluffy frost to fall; and, later, little local breezes caused little snowfalls from the trees. However, during the formation of this frost there must have been just enough atmospheric movement to prevent deposition on the north side, while on the south side of twigs, etc., there was a region of still air in which the moisture was crystallized.

The ultimate crystals of each fern-like flake were prisms and hexagonal plates. The parts formed by prisms and very small hexagonal plates corresponded to the rachis and basal portions of pinnæ, while the expanded portions of pinnæ and pinnules were represented by hexagonal plates alone. The terminal plates were the largest. They diminished in size as they approached the axils, where they were replaced by delicate elongate prisms.

These fern flakes are simply modifications of star-flakes. Each fern-flake is one ray of a star, the point of attachment to the twig or wire corresponding to the centre of the star. Their attachment to a fixed support was a condition of unusual development, some being more than one-half inch in length. The completed star would have been gigantic compared with a star-flake formed in a snow cloud.

Some of these fern flakes were still further modified so as to represent a half ray, resembling one-half of a fern frond divided longitudinally. Perhaps in such a one the axis of the fern-flake represented the line of demarcation between still air and moving air.

This was a kind of snow-cloud hanging on the trees, formed under the concurrence of particular conditions of temperature, moisture, and atmospheric movement. The conditions that favor the fringe-like, or one-sided, arrangement of frost must be very unusual.

W. P. SHANNON.

Greensburg, Ind.

On the Use of the Compound Eyes of Insects.

MY personal knowledge of Dr. Dallinger enables me to accept without hesitation his statement in *Science* of Jan. 6 (p. 11) that the wood-cut on page 908 of "The Microscope and its Revelations" corresponds in every particular with the photograph from which it was taken. I should, however, like to put myself right with your readers by explaining that the photograph to which I referred as "the original" was a positive print exhibited at the meeting of the Royal Microscopical Society on Nov. 19, 1890, by Professor Bell, who said that it had been sent by Professor Exner to Dr. Sharpe, by whom it was lent for exhibition on that occasion. I examined this photograph with much interest at the close of the meeting and took the opportunity of making a sketch of it in my note-book at the time. This sketch undoubtedly shows the letter R to be the right way about, with the church facing towards the left; and although after a lapse of two years it might not have been possible to trust entirely to memory in the matter, it is impossible to suppose that I made otherwise than a true copy of the picture which I held in my hand. I therefore infer that the photograph to which Dr. Dallinger refers must have been printed the reverse way to the one which I saw as above stated.

R. T. LEWIS.

Ealing, London, S. W., England.

AMONG THE PUBLISHERS.

THE publishers of Mrs. Helen Mather's "One Summer in Hawaii," the Cassell Publishing Company, announce a new edition of that book. The present state of affairs in Hawaii have renewed interest in the subject. Mrs Mather describes the people, their manners and customs, the natural resources of the island, and gives a personal description of Queen Lilliuokaulani, by whom she was entertained. The book is filled with illustrations showing the scenery and public buildings, and gives portraits of the Queen and her predecessors in office.

— G. P. Putnam's Sons announce for early publication "The Empire of the Tsars and the Russians," by Anatole Leroy-Beaulieu, translated from the third French edition by Mme. Ragozin; "Outlines of Roman History," by Professor Henry F. Pelham, of Oxford University, a work particularly designed for reading classes and higher-grade students; "Studies of Travel in Greece

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Feb. 21. — Mrs. Matilda Coxe Stevenson, The Foundation of the Zuni Cult; Miss Kate Foote, Dual Civic Functions: A Study in the Evolution of Institutions; Thomas Wilson, Early Man in the Mississippi Valley.

Biological Society, Washington.

Feb. 25. — Sheldon Jackson, The Introduction of Reindeer in Alaska; M. B. Waite, Variation in the Fruit of the Pear due to Difference of Pollen; E. M. Hasbrouck, On the Development of the Appendages of the Cedar Waxwing; F. A. Lucas, The Food of Humming-Birds.

Philosophical Society, Washington.

Mar. 1. — Waldemar Lindgren, Two Neocene Rivers of California; Marshall McDonald, A Study of the Gulf-Stream in Relation to the Tile Fish.

Appalachian Mountain Club, Boston.

Feb. 27. — C. Willard Hayes, Through Alaska with Lieutenant Schwatka; an account of exploration in the Yukon Basin in 1891, and the first crossing of the St. Elias-Wrangell Range.

Mar. 8. — Edouard A. Martel of Paris, will be read by Frank W. Freeborn, The Land of the Causses. The Caves of Bramabiau, Dargilan, Padirac, etc.; Philip Stanley Abbot, His Ascent of the Weisshorn.

Society of Natural History, Boston.

Mar. 1. — E. S. Morse, A Curious Aino Toy; C. Willard Hayes and M. R. Campbell, The Structural Features (Geomorphology) of the Southern Appalachians.

Agassiz Scientific Society, Corvallis, Ore.

Feb. 8 — Charles Pernot, Smokeless Fuel.

and Italy," a volume of historical and archæological papers by the late Professor Freeman; "Venice: an historical sketch of the Republic," by Horatio F. Brown. New issues in their various series will be "Napoleon," by W. O'Connor Morris, in Heroes of the Nations; "Story of Poland," by W. R. Morfill, in Story of the Nations; "The Silver Situation in the United States," by Professor F. W. Taussig, in the Questions of the Day Series. "Vertebrate Embryology," by Dr. A. Milnes Marshall, professor of zoölogy in Owens College, England, and C. H. Hurst, demonstrator of zoölogy in Owens College; and "A Junior Course in Practical Zoölogy," by the same authors.

— D. Lothrop Company announce "In the Wake of Columbus," an illustrated account of travel along the track of the great discoverer; "From Cordova to Cathay," by Frederick A. Ober, who was the special Columbus commissioner sent out by the World's Fair directory to gather facts and relics.

— The January *Century* has been out of print for some time, and of the February number the publishers now have unfilled orders for more than five thousand copies awaiting a new edition. A large first edition of the March *Century*, containing the Reminiscences of Napoleon at Elba, will be ready on the first day of March.

— At the recent meeting of the Indiana Academy of Science, Dr. Robert Hessler, of Indianapolis, read a paper on "An Extreme Case of Parasitism." It was a case of that extremely rare and almost extinct form of the itch known as "Norway Itch," the *Scabies Norvegica* of Hebra, and who first described it in 1852. The paper was prefaced by some remarks on the itch mite and on the itch. It was not until 1835 that the mite *Sarcopter scabiei*, De Geer, was universally recognized as the cause of the itch. There is no uniformity among medical authors concerning the scientific names for the mite. *Acarus scabiei* and *Sarcoptes hominis* are frequently given in medical works. The size is also variously given, from "very minute almost microscopic" up to "the size of a pin-head." Scabies, or the itch, is the result of the presence of the human itch mite on the body. Occasionally, although rarely, mites from the domestic animals produce a similar eruption on the human body. In an ordinary acute or epidemic case of the itch the number of mites is quite small, probably rarely exceeding one hundred adult animals. Norway itch is so rare that modern treatises on skin diseases, especially those of our country, do not describe it, very few even mention it. The writer is inclined to believe that a case of this kind corresponds, medically, to a "freak" or "sport" of the naturalist or evolutionist; it shows us what was formerly of frequent occurrence — owing to uncleanliness and a want of proper parasiticides. The afflicted man when first seen was covered with thick, creamy-white, leathery scales. "He was covered with scales like a fish." Some of these scales measured over one inch in diameter and one-tenth inch in thickness. These scales were not crusts or scabs, they were overgrowths of the skin due to increased cell activity from the irritation of the mites. A constant shedding of these scales was going on, a handful could be gathered daily. In a search for the cause of this skin eruption, the doctor found the mites and at once established the diagnosis. The epithelium, that is, the scales, were found to be full of mites and eggs and riddled with burrows or passages. Under appropriate remedies the mites were soon exterminated. The cause of the disease once removed, the skin soon regained its normal character and the patient was cured. Dr. Hessler made a calculation of the total number of mites and eggs on the body of the man when first seen. Pieces of scale of a definite size were stained, imbedded, sectioned and mounted in serials. Diagrams were made of each section, indicating the position of the mites and eggs, and the count made therefrom. A simple calculation gave the figures for the entire body. Here are the results: Eggs and empty shells, 7,004,000; mites in all stages of development, 2,009,000.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale—A Zentmayer new model U. S. Army Hospital monocular stand. Price $110, will sell for $75. Address H. C. Wells, No. 151 Broadway, New York.

For sale—A complete set of the third series of the American Journal of Science (1870-1895) handsomely bound in single volumes in dark brown half morocco. Address G. H. Williams, 808 Cathedral Street, Baltimore, Md.

For sale, or for exchange for books on medicine or surgery, new editions only, a large geological library, containing nearly all the State and Government Reports since 1855. Will be pleased to answer letters of inquiry and give information. Address R. ELLSWORTH CALL, Louisville, Ky.

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For exchange.—Will exchange an "Ideal" Microscope of R and J. Beck, London, 2 eye pieces 3 objectives, 3 inch, 1 inch, 1-6 inch; bull's eye condenser on stand, substage condenser, mechanical stage, etc., for any of the leading makes of type writers. Particulars by mail. DELOS FALL, Albion College, Albion, Mich.

Sale, or exchange for similar material; Diatoms (Isthmia nervosa), unmounted, from San Francisco Bay. M. J. ELROD, Bloomington, Ill.

For sale or exchange.—I have a few copies of my translation of "Strasburger's Manual of Vegetable Histology, 1887," now out of print, which I will send post-paid for $3 or for one dozen good slides illustrating plant or animal structure. Address A. B. Hervey, St. Lawrence University, Canton, N. Y.

The undersigned has the following specimens to exchange for crystals of any eastern or foreign localities or Indian relics: tin ore, metacinnabarite, stibnite, garnierite, calenanite, hanksite, ulexite, rubellite, lepidolite, blue and green onyx, Cal. pineite, aragonite on chalcedony, cinnabar, double refracting spar, clear and clouded, and others. J. R. Bush, care of General Delivery, Los Angeles, Cal.

For sale or exchange.—A private cabinet of about 200 species of fossils, well distributed geologically and geographically. Silurian, about 40; Devonian, about 50; Carboniferous, about 60; others, about 30. Frank S. Aby, State University, Iowa City, Ia.

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